BOSTON UNIVERSITY

SCHOOL OF EDUCATION

Thesis

A STUDY IN THE RELATIONSHIP OF PHYSICAL STRENGTH AND PERSONALITY TRAITS

Submitted by

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B. S. in Education

Boston University, 1936

In partial fulfillment of requirements

for the degree of Master of Education

1938

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A STUDY IN THE RELATIONSHIP

Of

PHYSICAL STRENGTH and PERSONALITY TRAITS

-- OUTLINE --

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2. Introduction

   (a) Purpose: To find what is the relation between physical strength and each of the following adjustments as defined by Bernreuter; emotional stability, self-sufficiency, introversion-extroversion dominance-submission, self-confidence and sociability.

   (b) Justification of Instruments

   (c) Method: Test a group of individuals, using the Personality Inventory and the identical group with the Physical Fitness Index, at the same time. Correlate the Physical Fitness Index scores with each of the six Bernreuter scores.

   (d) Results: Determine significance.

3. Body

(a) Procedure

1- Group used must not be younger than high school age.

2- Both tests should be given at the same time.

3- If more than one Physical Fitness Index is given, the best score is used for correlation.

4- Correlate each personality score with the strength test score.

5- Graph the results with the same test of the others in the group

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A STUDY IN THE RELATIONSHIP
Of
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I. Introduction

In the last few years, with the growth and standardization of tests, the individual has been divided conveniently into parts, by imaginary lines. Each part, as defined, has been measured, and, by placing his score with those of others, his position may be understood. Comparative studies have been the second step. Students' interests have led to determine what relation exists, if any, between the measures of intelligence and physical capacity; between mechanical ability and intelligence; between personality traits and aptitudes; but, as far as I can determine, no study has yet been made to find what relation exists between physical strength and phases of the personality.

In choosing the instruments of testing, there are many points of consideration. Both, Bernreuter's Inventory and Rogers' Physical Fitness Index are very inclusive measures. The Personality Inventory covers six phases of the personality, divided and defined by Bernreuter as measures of neurotic tendencies, self-sufficiency, introversion-extroversion,

dominance-submission, self-confidence and sociability. The results of the physical tests are obtained from a battery of tests given after a doctor's medical examination, including lung capacity, grip strength, two different measures of arm strength, back strength and leg strength. These scores are correlated with the age, height, and weight of the individual, and the result is his strength index, or his physical capacity.

The question of time and convenience of the tests has been of great importance. The individuals in this study have been students; and school administrators are reluctant to give up a great deal of time. Nor do they wish to be inconvenienced by long intricate tests. The Inventory may be given to groups of any size within a comparatively short time, averaging fifteen minutes. The physical tests are given in an average of two minutes to an individual.

The term "personality" has been used so widely, with varying degrees of meanings, both technical and conversational, that a detailed explanation of its meaning in relation to this study is necessary.

Psychologically, there are two phases which make up the total personality:

A- Geno-type:

That side of the personality which is purely constitutional. Its make-up is determined by the gene, and is physiological. There are three elements included in the geno-type which are persistent and constant, no matter what the experience, no matter what the environment.

(1) Inherent cravings (desires); hunger; love; necessity for preservation and propagation of life.

(2) Basic Mood; tone of emotional life, determined constitutionally, chiefly by metabolism.

(3) Psycho-motality; speed, power, energy, persistence of actions and reactions, rhythm of psychic life.

This phase of the personality, the geno-type, does not change, nor can it be altered, except through disease or injury to the brain.

B- Pheno-type:

What the individual appears to be. It is the personality in combination with the environment. He is culturally and environmentally conditioned. This phase is the manifestation of his personality and may change by (1) modification to en-

vironment, (2) adjustment to environment and (3) transference of energy.

It is obvious, then, that in order to get a true picture of the personality, both phases must be measured. Without a question, the Bernreuter Inventory measures the pheno-type, the manifestation of the personality. But the question: Does the Personality Inventory measure the fundamental (geno-type) basis of personality? is more difficult to answer.

The test, as stated previously, is divided into six sections. Obviously they do not all measure the geno-type alone; nor were they so intended. But they measure as many different manifestations which may reflect the fundamental basis with reliability and validity.

The definitions given by Bernreuter in his manual, for the purpose of clearer interpretation are relatively simple: "B1-N-- A measure of neurotic tendency. Persons scoring high on this scale tend to be emotionally unstable; those scoring low tend to be very well balanced emotionally. B2-S-- A measure of self-sufficiency. Persons scoring high on this scale prefer to be alone, rarely ask for sympathy or encouragement, and tend to ignore the advice of

others. Those scoring low dislike solitude and often seek advice and encouragement. B3-I-- A measure of introversion-extroversion. Persons scoring high on this scale tend to be introverted--that is--they are imaginative and tend to live within themselves. Those scoring low are extroverted; that is, they rarely worry, seldom suffer emotional upsets, and rarely substitute day dreaming for action. B4-D-- A measure of dominance-submission. Persons scoring high on this scale tend to dominate others in face to face situation. Those scoring low tend to be submissive. F1-C-- A measure of confidence in oneself. Persons scoring high on this scale tend to be hamperingly self-conscious and to have feelings of inferiority. Those scoring low tend to be wholesomely self-confident and to be well adjusted to their environment. F2-S-- A measure of sociability. Persons scoring high on this scale tend to be non-social, solitary or independent. Those scoring low tend to be sociable and gregarious." 1/

Is it not obvious from these definitions given by the author of the test that both the geno-type and pheno-type are being measured? Is it not possible that a poor adjustment in any phase may be caused either by a physical defect of an environmental cir-

1/Robert G. Bernreuter - Manual for the Personality Inventory.

cumstance? And of course in some cases it may be both. It is impossible to draw a line separating the two types in this inventory. Other factors influence the personality, such as compensation, for which there is no measure. But compensation is an important phase of the pheno-type and its reflection is on the personality as a whole.

No one test is wholly valid. With the increase in numbers of tests validity rate grows higher, accordingly. The interpretation must be made from the result of the total test. The basic elements must be reflected, in part, in each unit of the inventory. They may be identified, therefore, by combining the tests and recognizing similar phases in each.

(1) Table 1. COEFFICIENTS OF RELIABILITY AS GIVEN BY BERNREUTER

STANFORD UNIVERSITY ELEMENTARY PSYCHOLOGY STUDENTS		
	FALL QUARTER CLASS (N. 70)	WINTER QUARTER CLASS (N.128
B1-N	.91	.88
B2-S	.92	.85
B3-I	.89	.85
B4-D	.89	.88

The scores "were computed by using the split-half method and applying the Spearman-Brown prophecy formula." 1/ The subjects in each class were entirely

1/Robert G. Bernreuter - Manual for the Personality Inventory

different groups.

The various scores were validated by correlating them with:

(a) Thurstone Neurotic Inventory

(b) Bernreuter Self-Sufficiency Test

(c) Laird C-2 Introversion Test

(d) Allport Ascendance-Submission Reaction Study

(2) Table 2. COEFFICIENTS OF VALIDITY AS GIVEN BY BERNREUTER

STANFORD UNIVERSITY ELEMENTARY PSYCHOLOGY STUDENTS			
FALL QUARTER CLASS			
	N.	Uncorrected	Corrected
B1-N, TN	70	.94	1.00
B2-S, SS	70	.89	1.00
B3-I, C2	70	.76	.99
B4-D, AS(Men)	55	.81	1.00
B4D, AS(Women)	...	...	...
WINTER QUARTER CLASS			
	N.	Uncorrected	Corrected
B1-N, TN	32	.91	.99
B2-S, SS	46	.86	1.00
B3-I, C2	44	.69	.92
B4-D, AS(Men(	55	.67	.84
B4D, AS(Women)	29	.82	.99

Bernreuter gives an interesting table of intercorrelations showing a close relationship between the

B1-N, B3-I, and F1-C scales. He suggests that "little is gained through using more than one of these three scales---B1-N is probably to be preferred, because it has a higher reliability."

The term "Physical Fitness" is more correct in its everyday usage than the term personality. Its meaning has not been stretched to cover a multitude of phases, as has the term personality. We know exactly what any man means when he declares himself physically fit. But for specific reasons we should define this term as "capacity for purposeful physical activity".[1/] Capacity implies a cubic or three dimensional measure. In its application to physical fitness it signifies power, endurance and efficiency of activity. The source of these qualities is health, for with diminishing health there is diminishing activity to the lowest extreme of death, where no activity exists. Going in the reverse direction there is great activity and what the layman calls excellent health.

But why do we measure strength to determine health? Because the muscular strength is the manifestation of the power, endurance and efficiency of an individual's activity. Bodily fatigue, nervous disorders and disease are all reflected in the strength

1/ F. R. Rogers - Fundamental Administrative Measures in Physical Education.

needed for everyday activity. A person recovering from a recent illness tires easily; a common cold impairs the efficiency of a worker; a nervous individual keeps his physical being in a constantly weakened condition by useless expenditure of energy and his strength for needful tasks is lessened. It is obvious that strength and physical fitness are interrelated and without one there can not be the other.

However "the validity of strength tests as measures of physical fitness depends on the fact that muscular exercise increases the strength of muscles while at the same time improving general physical fitness". 1/ In other words, not all exercise is beneficial. It is possible to destroy health by improperly supervised activity. In cases of athletes who apparently have excellent health and possess an abundance of strength there are examples of over-fatigue as the result of a long season of sports. Under these conditions physical fitness scores actually become lower as the daily practice continues. Muscular repair cannot keep up with energy output, and the whole body is being over-taxed which of course is detrimental.

1/ F. R. Rogers - "Fundamental Administrative Measures in Physical Education"

In determining the reliability of his strength tests, Dr. F. R. Rogers has used two methods: the probable error method, and the reliability coefficient. The second measure is found by correlating the scores of two series of tests on the same group of individuals allowing not more than a week to elapse between the first and second tests. When a longer period comes between the tests the reliability coefficient is lower. The following table of coefficients is the result of tests given in May and again in September, and though the results are very high, they would have been higher obviously, had the tests been given at the end of a two week's interval, rather than three months.

(3) Table 3. COEFFICIENTS OF RELIABILITY OF CERTAIN PHYSICAL CAPACITY TESTS

STRENGTH TEST BATTERY	
Lung Capacity	.97
Right Grip	.92
Left Grip	.90
Back Strength	.88
Leg Strength	.86
Pull-Ups	.91
Push-Ups	.90

The problems of individuals to be tested under the specifications and limitations was solved by the kind cooperation of eight Seventh Day Adventist Aca-

demies, colleges, and nurses' training schools. Although nearly seven hundred tests were given, only five hundred and ten could be used for several reasons: The physical and personality tests were not given on the same day. Every individual who took the Bernreuter test could not take the physical test because of injury, recent surgery, heart trouble or other similar physical disability. Some students neglected to answer all questions on the inventory sheet, making the test unreliable. In some cases the complete battery of physical tests were not given.

Therefore, the cases included in this study are complete in every way, and as reliable and valid as it is possible to make them.

So much has been assumed in the relation of physical prowess and personality that the two capacities have been linked together for generations, in literature, folk-lore and music; not to mention our current moving pictures and our everyday conversation. The question put before any layman today: "Do you think strength of body has anything to do with a strong personality?" will inevitably bring forth the reply: "Of course; all strong personalities have strong bodies, or at least, most of them do."

The layman's idea of what is a "strong personality" varies. He defines it in terms of attractiveness, sociability, steady nerves, confidence in himself, a born leader, aggressiveness, etc. In our literature and music, endless examples can be cited: Homer's Odysseus, Achilles, Robinson Crusoe, Siegfried and Manrico. In history, there seems to be no end of heroes.

Yet with all these cases, nothing has been proved. Does a "Strong" personality, in most cases, have a strong body, or does the strong body tend to develop a "strong" personality? Or, is the combination of the two so infrequent that when they occur in the same individual, he is outstanding in the capacity of a great leader or a hero?

II. BODY

The students tested in this study are ranging in ages from eleven to twenty-one. Their placement in school grades includes high school, colleges and nurses' training schools, which are comparable with the college groups. Bernreuter has devised "norms" for all aged groups above the secondary school ages, but no adult group was available for both the physical and personality tests to be given at the same time.

The question arises as to whether the manifestations and growth of the personality will make a significant difference in the correlations of scores, between the adolescent and the adult. The adult has supposedly reached a more stable plane both physically and emotionally, while the adolescent's development may not be equal in all phases. The scores of all individuals of college age were separated from the other scores in the test of neurotic tendency (Bl-N). To discover whether this supposition would reflect in the correlation, each group was correlated separately with its physical fitness scores. In the larger group there are many more scores at the extreme ends of the scale. The answer is quite clear. In a specialized college group the individuals are all subjected to a similar mode of living. Their routine of study, exercise, play, and sleep conforms to their college requirements. In these particular cases all students are living in dormitories, so that there is not even a variety of home conditions to influence the scores. Yet with all these limitations there is only a difference of 0.03 of a point.

Not enough has been said about the purpose of giving the Physical Capacity Test at the same time as the Bernreuter Inventory. In this study, both

tests were given on the same day in the majority of cases. No scores were included when more than a day elapsed between the testing.

The importance of this procedure is that neither test is constant and the physical tests are particularly variable. It is the fluctuation of an individual's score that makes the physical capacity test invaluable. We could not prescribe, nor could we plan progressive programs of health if we could not re-test to find that our prescription has raised the score in the second or third test. We could have no way of determining in which direction we were going, the right or the wrong. Suppose, for instance, a program of activity is carefully planned by a director of Physical Education in a large high school. Each entering freshman is given a medical examination, followed by a Physical Fitness Test, providing the medical examination shows no prohibitive disorders. At the end of the year each freshman repeats his examinations and tests. The effectiveness of the freshman activity program may now be determined. If the majority of student scores are higher at the end of the year the program is beneficial. But if the scores remain the same, or are lower than at the time of entering, the activities

are harming rather than helping the students. By carrying this procedure over a period of years it will be seen that with changes of programs, the margin of difference in scores is wider or narrower. By constant observation, activities of no consequence may be discarded, thereby building a better program every year.

The variability of the Bernreuter Inventory depends on the six phases of the personality that are measured. It is possible to name an incident which would influence one or more of the six scores. An unhappy social relationship would certainly influence the measure of sociability. A change of schools or environment may be "the making of a boy", by restoring his confidence. A sudden death or accident in the family may alter an adolescent's whole attitude toward life. Hollingworth found that neurotic World War soldiers tested immediately after the Armistice, made responses quite different from those they had made before. We, therefore, have avoided any possibility of giving the tests under different condition, and have used only test scores that are not more than one day apart.

(4) Table 4. COEFFICIENTS OF CORRELATION OF P.F.I. SCORES WITH THE BERNREUTER PERSONALITY INVENTORY SCORES

		COEFFICIENT	N
B1-N	P.F.I.	.008	510
B2-S	"	.011	
B3-I	"	.008	
B4-D	"	.041	
F1-C	"	.22	297
F2-S	"	.00005	

The reason for the smaller number of cases in the F scales is that there are no norms given for the high school girls. The two hundred and ninety-seven tests are those of college girls, and high schools and college boys.

Four of the above coefficients of correlation are negative and no coefficient is of specific significance. As a general statement it may be said that there is no relation whatsoever between a strong body and the six phases of personality as measured by Bernreuter. The tendency as a whole is exactly opposite from the popular conception of the strong body being free from neurotic symptoms, for example: From this we may conclude that the majority in a group of persons with high P. F. I. scores

tend to be neurotic and introverted, but they are no more social than their weak friends. This tendency, however, is very slight, and without reading into the figures meanings that are not there, the conclusion must be that relationship between physical strength and these personality traits does not exist.

Still searching for a possibility of a relationship, correlations were run between selected groups. The fifteen highest P. F. I. scores were listed with the Bernreuter scores of those individuals, and each test was averaged. The same was done with the fifteen lowest P. F. I. scores. The result is shown:

(5) Table 5. COMPARISON OF AVERAGES OF HIGHEST AND LOWEST P.F.I. SCORES, WITH THE BERNREUTER PERSONALITY INVENTORY SCORES

	AVER. P.F.I.	AVER. B1-N	AVER. B2-S	AVER. B3-I	AVER. B4-D
15 Highest P.F.I.Scores	167	46.8	46.6	44.3	41.7
15 Lowest P.F.I.SCORES	71	52.6	42.2	51.2	46.8
Difference in Averages	86	5.8	4.4	7.2	5.1

Although the difference of averages is great in the P.F.I. scores there is no significant differ-

ence in the Personality Inventory averages.

Coefficients of Correlation were found in four groups, namely, the highest and lowest P.F.I. scores of the B2-S scores and B3-I scores.

(6) Table 6. COEFFICIENTS OF CORRELATION OF HIGHEST AND LOWEST P.F.I. SCORES AND SCORES OF THE BERNREUTER PERSONALITY INVENTORY

	COEFFICIENT
15 Highest P.F.I. Scores--B2-S	.128
15 Lowest " " --B2-S	.0034
15 Highest " " --B3-I	.003
15 Lowest " " --B3-I	.006

Again no relationship is evident, even in selected scores.

The answer to the question "Why?" can only be subjective. The psychological factor called compensation is probably the strongest factor which influences the relationship of physical fitness and personality traits. It is evidently strong enough to make those individuals with low P.F.I. scores develop personality traits equal to those who already benefit from an abundance of strength. While perhaps those with higher scores find no challenge nor necessity for making an effort to dominate or to be social.

Contrary to popular opinion, one is no freer from neurotic tendencies if his body is strong rather than weak. This conclusion coincides with Freudians and other schools of psychology which contend that neurosis is a disease of the unconscious, and the physical being has no bearing on its development.

III. CONCLUSION

Referring back to our heroes of literature, music, and art, we find that it is they who are the exceptions. They possess both exceptional strength of body and personality traits. They are outstanding among men and therefore become the subject for honor and praise.

Excluding these exceptions we find that a relationship does not exist between physical fitness and any of the six personality traits as measured by Bernreuter. There is no possible way of predicting a man's strength by any of his personality scores. Nor is it possible to say that because a man is weak he will probably be less dominant and more introverted. It must be remembered that these cases are all individuals who have sufficient health to pass a thorough medical examination before taking the physical Capacity tests. These conclusions are

based entirely on "well" people, though their P.F.I. scores run from 269 to 67.

The development of personality and of strength are apparently two indepentent forces. Their influence, one upon the other, cannot be determined in a group as a whole. We can find no evidence that there is any relationship between physical fitness and personality traits.

APPENDIX

In selecting tests for this study many points of consideration restricted the field to using the Bernreuter's Personality Inventory and the Physical Fitness Index by Rogers.

It is obvious that a group of trained individuals should be responsible for the best results of a physical test of any sort. The tester who has had experience is able to interpret the effort, the enthusiasm and the interest, which of course influences physical energy and test results. Having available experienced testers, who were trained by the author of the Physical Fitness Index, was a great advantage, the importance of which could not be overlooked.

Though this was very important it was not the only point of consideration. The standardization of the battery of tests with their norms, the reliability being as high as 0.94-0.97 and the validity, all quoted in this study, were the reasons for my choice.

Bernreuter's Personality Inventory suited the subject of this study and measured a wider scope of phases of the personality to be used for comparison.

The Laird Personality Inventory B-2 claims to measure neurotic tendencies or emotional instability, but it correlates low with Bernreuter's measure of the same variable (0.63 and 0.56), showing a difference in the phase being tested. The Pressey X-O Test measures Affectivity and Idiosyncrasy, defined as another test of emotional instability. But the correlations of these with Laird are lower still, denoting a third definition of emotional instability. These measures were not considered because of their limited range. I wished to measure as many different aspects as possible, and the two Personality Inventories qualifying most satisfactorily were Thurstone's Adjustment Inventory and Bernreuter's Personality Inventory.

Thurstone's Adjustment Inventory was compiled from Woodworth's Psychoneurotic Inventory, House's monograph, Laird's Personality Inventory, Freyd's list of introvert and extrovert traits, and Allport's ascendance-submission test. The final form, as it now stands is divided into four separate measures, namely: Home-Adjustment, Health-Adjustment, Social-Adjustment and Emotional-Adjustment. Each unit contains thirty-five questions totaling one hundred

and forty in all. Of these, ninety questions are composed by Thurstone and forty-nine from other sources. Like the Bernreuter Inventory this is a self-administering test. The directions are read aloud to make it more clear when given to a group. In neither test is there a time limit, though the maximum time needed for the Thurstone is about one half an hour, and ten minutes less for the Bernreuter. The greatest time saving advantage is in the scoring. Bell 1/ claims that three minutes only is required to score Thurstone using the underweighted method, while it takes approximately thirty minutes to score the six parts of Bernreuter.

In comparing the value of both tests in view of their use in this study, Bernreuter's Inventory divides the traits which he calls summarily, personality, into smaller parts. Six scales of measuring personality make a finer distinction and cover a broader field. Quoting from Bell: "The value of the Bernreuter test-----has been increased recently through the publication by Flanagan of two new scoring scales to measure Self-confidence and Sociability".

Since Bernreuter obtained many of his questions from the same source as Thurstone it is not surprising that many questions are identical.

1/ Hugh M. Bell "The Theory and Practice of Student Counciling"

For example: "Are you troubled with feelings of inferiority?", "Do you consider yourself a rather nervous person?", "Do you ever cross the street to avoid meeting someone?" The question: "Are you troubled with shyness?" also appears in both tests and by scoring it according to Thurstone we get one interpretation and one value: Yes = -6, no = +5, ? = -2. The affirmative answer is significantly neurotic, the negative is not as important and the question shows only a tendency. Whereas the same question has six different weights in the Bernreuter scale, interpreting its meaning in the light of six phases of the personality.

"Are you troubled with shyness?"						
WEIGHTS GIVEN BY BERNREUTER						
	B1-N	B2-S	B3-I	B4-D	F1-C	F2-S
Yes	6	-1	2	-4	8	2
No	-7	1	-2	6	-5	0
?	1	-1	1	-3	4	2
Total Evaluation	14	3	5	13	17	4

Ranking this question in order of its value in the scales it is given greatest significance under Self-Confidence. If a yes answer is circled it shows

a marked lack of this trait, while if the negative is circled the important trait is the neurotic. Self-Sufficiency, Introversion and Sociability have little relation to shyness in this question. In other words a person who is shy suffers from lack of confidence, has a tendency to be neurotic and submissive. Even if he is indecisive and the question is marked, the interpretation is carefully weighted. Lack of confidence again is given the highest value, with lack of dominance one point lower in importance.

Each category in the Thurstone Inventory includes all of the personality traits as measured by Bernreuter. In the first, for example, Home-Adjustment, a low score denoting poor adjustment may be caused by one of the traits measured by Bernreuter, a combination, or all of them. Measuring Home-Adjustment is very useful in student counseling, but it does not specify any one personality trait. Poor Social-Adjustment may be the result of either too much, or not enough of the trait called dominance. It may be a combination of neurotic and introverted tendencies. These adjustments are the manifestations of personality traits, not the source.

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G R A P H I

CORRELATION COEFFICIENT

OF

B1-N, P. F. I.

COLLEGE GROUP

-o.047

I

COLLEGE P.A.I. / BI-N	224-215	214-205	204-195	194-185	184-175	174-165	164-155	154-145	144-135	134-125	124-115	114-105	104-95	94-85	84-75	74-65	d	f
91-100										:		..	..	...	..	.	5	12
81-90							.			..		.	..	...			4	9
71-80							.	.		....		.	....	.	..		3	10
61-70				.				..		.		..	.	....			2	11
51-60							.	.	.	...	....	....	..	..	..		1	20
41-50										.	..	..	..	.	.	.		10
31-40										..	.	.		....			-1	12
21-30							..			.	..	....		..	.	.	-2	12
11-20									.		.	..	.	...			-3	9
1-10					.					.	.	.	..	.	....	.	-4	12
d				-8	-7	-6	-5	-4	-3	-2	-1		1	2	3	4	N=	122
f				1	1		5	2	4	12	16	20	17	25	12	4		-.047

G R A P H II

TABLE OF AVERAGES

OF

FIFTEEN HIGHEST

AND

FIFTEEN LOWEST

P. F. I. SCORES

	P.F.I.	SEX	B1-N	B2-S	B3-I	B4-D	F1-C	F2-S
1	269	F	8	50	12	92		
2	222	M	38	42	36	5	37	38
3	177	M	5	73	9	64	6	21
4	164	F	21	52	12	41	18	54
5	163	F	42	72	38	32		
6	163	F	86	22	89	.99		
7	161	M	60	62	60	43	52	47
8	161	F	6	91	12	86		
9	160	M	80	31	81	19	88	78
10	159	M	76	50	76	55	60	51
11	159	F	56	41	50	48	46	21
12	159	M	41	38	44	76	34	38
13	157	F	23	7	18	30	36	4
14	156	F	82	49	70	14	88	31
15	159	F	78	20	58	22	78	37
AVERAGE	167		46.8	46.6	44.3	41.7	54.3	38.1

	P.F.I	SEX	B1-N	B2-S	B3-I	B4-D	F1-C	F2-S
67		M	60	82	52	83	37	85
68		F	82	5	81	7		
69		F	48	-4	34	35		
69		F	72	28	73	44		
70		F	61	5	54	41		
71		F	30	66	30	76		
72		F	19	53	18	62		
72		M	40	70	40	78	37	41
72		F	98	2	98	6	99	45
73		F	55	63	54	50		
73		M	42	18	43	2	83	8
74		F	93	-1	96	3		
74		M	10	77	27	86	8	60
74		M	24	83	31	58	50	56
76		F	55	87	62	71		
71			52.6	42.2	57.5	46.8	52	49

DIFFERENCE OF AVERAGES	P.F.I.	B1-N	B2-S	B3-I	B4-D	F1-C	F2-S
	96	5.8	4.4	7.2	5.1	2.	11

G R A P H III

CORRELATION COEFFICIENT

OF

B1-N, P. F. I.

0.008

BI-N / P.F.I.	224–215	214–205	204–195	194–185	184–175	174–165	164–155	154–145	144–135	134–125	124–115	114–105	104–95	94–85	84–75	74–65	d	f
91–100					·		·	·	····	····	····	····	····	····	···	·	4	46
81–90							··	·	····	····	····	····	····	····	··	·	3	45
71–80							····	···	····	····	····	····	····	····	····	·	2	54
61–70				·			·		····	····	····	····	····	····	·	·	1	50
51–60							··	···	····	····	····	····	····	····	····	··		71
41–50							··	··	·	····	····	····	····	····	····	··	-1	62
31–40	·							····	····	····	····	····	····	····	··	··	-2	61
21–30					·		··	·	·	····	····	····	····	····	···	··	-3	47
11–20									····	····	····	····	····	····	·	·	-4	33
1–10	·				·		·		····	····	·	····	····	····	····	·	-5	41
d	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1		1	2	3	4		
f	2			1	2	1	13	15	35	70	65	90	84	78	40	14	N=570	
																		.008

G R A P H IV

CORRELATION COEFFICIENT

OF

B2-S , P. F. I.

0.011

IV

B2-S PAI	224-215	214-205	204-195	194-185	184-175	174-165	164-155	154-145	144-135	134-125	124-115	114-105	104-95	94-85	84-75	74-65	d	f
91-100							·		····	····	····	···	····	····	·		5	31
81-90								··	··	····	····	····	····	····	···	··	4	47
71-80					·	·	·	·	··	···	····	····	····		····	·	3	29
61-70							·	··	·	··	····	····	·	····	····	····	2	40
51-60	·			·			·	··	····	····	····	····	····	····	····	·	1	46
41-50	·						····	···	····	····	····	····	····	····	····			75
31-40							··		····	····	····	····	····	····	··		-1	52
21-30					·		·	··	····	····	····	····	····	····	····	·	-2	66
11-20							·	·	··	····	····	····	····	····	····	·	-3	64
1-10					·		·	·	···	····	····	····	····	····	····	····	-4	60
d	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1		1	2	3	4	N=510	
f	2			1	2	1	13	14	35	70	68	92	81	81	36	14	.011	

G R A P H V

CORRELATION COEFFICIENT

OF

B4-D , P. F. I.

0.041

D4-D \ P.F.N	174-165	164-155	154-145	144-135	134-125	124-115	114-105	104-95	94-85	84-75	74-65	d	f
91-100	··	·	··	····	····	··	··	····	····	·		5	23
81-90	·	·	··	··	····	····	····	····	····	···	··	4	49
71-80			··	····	····	····	····	····	····	···	··	3	42
61-70	···	·	····	··	····	····	····	····	····	···	·	2	48
51-60		··	··	····	····	····	····	····	···	···		1	58
41-50		···		····	····	····	····	····	····	····	····		55
31-40		····	·	···	····	····	····	····	····	··	·	-1	53
21-30		··	·	···	····	····	····	····	····	····		-2	73
11-20	··	·	··	····	····	····	····	····	····	····		-3	64
1-10	··	··	···	··	····	····	····	····	····	··	···	-4	61
d	-6	-5	-4	-3	-2	-1		1	2	3	4	N= 526	
f	10	16	16	35	67	69	97	97	75	32	12		.041

G R A P H VI

CORRELATION COEFFICIENT

OF

F1-C , P. F. I.

-0.22

IA

F1-C	P.F.I. 174-163	164-155	154-145	144-135	134-125	124-115	114-105	104-95	94-85	84-75	74-65	d	f
91-100												4	16
81-90												3	29
71-80												2	24
61-70												1	31
51-60													44
41-50												-1	35
31-40												-2	23
21-30												-3	29
11-20												-4	23
1-10												-5	15
d	-6	-5	-4	-3	-2	-1		1	2	3	4	N=269	
f	4	13	7	25	43	35	56	46	28	8	4	-.22	

G R A P H VII

CORRELATION COEFFICIENT

OF

F2-S , P. F. I.

0.00005

VII

F2-S P.F.I.	224-215	214-205	204-195	194-185	184-175	174-165	164-155	154-145	144-135	134-125	124-115	114-105	104-95	94-85	84-75	74-65	d	f
91-100									·	··	··	·		··			6	8
81-90				·				·	·	···	·	····	:::	··	·	·	5	22
71-80							··	·	·	···	··	····	····	····	··		4	20
61-70								·	···	···	··	:::·	···	····	·		3	23
51-60							··		··	··	····	····	····	::::		··	2	31
41-50							·			::··	··	····	····	····	····	··	1	26
31-40	·						···		·	····	:::·	:::·	::··	····	··			38
21-30				·			·		···	···	:::·	:::·	::··	····	·		-1	31
11-20								···	····	:::·	:::·	:::·	::··	····	··		-2	47
1-10							·		····	:::·	:::·	:::·	:::·	·	····	·	-3	51
d	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1		1	2	3	4	N=	297
f	1			1	1		10	6	22	45	42	55	46	44	18	6	.00	005

G R A P H VIII

CORRELATION COEFFICIENT

OF

B2-S , 15 HIGH P. F. I.

0.128

VIII

HIGH P.F.I. B2-S	P.F.I 269-260	259-250	249-240	239-230	229-220	219-210	209-200	199-190	189-180	179-170	169-160	159-150	d	f
91-100											•		4	1
81-90													3	
71-80										•	•		2	2
61-70											•		1	1
51-60											•			
41-50	•				•					•		•••	-1	5
31-40											•	•	-2	2
21-30											•		-3	1
11-20												•	-4	1
1-10												•	-5	1
d	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1			N = 15	
f	1				1					1	6	6		.128

G R A P H IX

CORRELATION COEFFICIENT

OF

B2-S , 15 LOW P. F. I.

-0.0034

IX

B2-S Low R.F.I. \ R.F.I.	79-75	74-70	69-65	64-60	59-55	54-50	49-45	44-40	d	f
91-100									5	
81-90	·	·	·						4	3
71-80		·							3	1
61-70		···							2	3
51-60		·							1	1
41-50										
31-40									-1	
21-30			·						-2	1
11-20		·							-3	1
1-10		..	·						-4	3
.99-.90		·	·						-5	2
d	-1		1	2						
f	1	10	4							

N = 15

-.0034

G R A P H X

CORRELATION COEFFICIENT

OF

B3-I , 15 HIGH P. F. I.

0.003

X

HIGH P.F.I. / B3-I P.F.I.	269-260	259-250	249-240	239-230	229-220	219-210	209-200	199-190	189-180	179-170	169-160	159-150	d	f
91-100														
81-90											:		4	2
71-80												:	3	1
61-70												:	2	1
51-60											:	:	1	2
41-50												:		2
31-40					:						:		-1	2
21-30													-2	
11-20	:										:	:	-3	4
1-10										:			-4	1
d	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1		1		
f	1				1					1	6	6		

N = 15

.003

G R A P H XI

CORRELATION COEFFICIENT

OF

B3-I , 15 LOW P. F. I.

0.006

XI

Low P.F.I. / B3-I P.F.I.	79-75	74-70	69-65
91-100		:	
81-90			·
71-80			·
61-70	·		
51-60		:	·
41-50		·	
31-40		:	·
21-30		:	
11-20		·	
1-10			
d	-1		1
f	1	10	4

d	f
4	2
3	1
2	1
1	1
	3
-1	1
-2	3
-3	2
-4	1

N = 15

.006